

Laboratory Ventilation Management Program

System Commissioning

**Thomas C. Smith
Exposure Control Technologies, Inc.**

Purpose and Objective

Maximize System Effectiveness

- **Safety**

- **Dependability**

- **Efficiency**

 - Energy Use

 - Use of Resources (Human Energy)

- **Flexibility**

Safety #1



Results of Tracer Gas Containment Tests

	Total
Number of Hoods	1671
% of Total Number of Hoods	100%
Number Passing TG Criteria	1418
% of Hoods Passing TG Criteria	85%

- CAV and VAV Hood Systems
- Hood Types:
 - Bench Top
 - Distillation
 - Walk-In
- Horizontal and Vertical Sashes
 - Only 37% with sash opening height more than 22 inches
- Primarily AI Tests
- Primarily 4 lpm Generation Rate
- Primarily 67" Mannequin Height

Factors Affecting Fume Hood Performance

- **Nature of Hazardous Procedures**
- **Fume Hood Design**
- **Laboratory Design (Cross Drafts)**
- **Ventilation System Design and Operation**
- **Work Practices**

The Laboratory Ventilation Management Program

- **Characterize Hazardous Procedures**
- **Ensure Appropriate Hoods**
- **Ensure Proper System Design**
- **Ensure Proper System Installation**
- **Commission System to Verify Proper Operation and Performance**
- **Train Users - Ensure Proper Use**
- **Test and Maintain Proper Operation**

Laboratory Hood Commissioning

■ Evaluate Design and Objectives

- Evaluate Design Assumptions
- Sequence of Operations
- Operating Modes

■ Verify Predictable Operation

- Proper Hood and System Installation
- Lab Conditions
- Supply and Exhaust Capacity
- Supply and Exhaust Stability

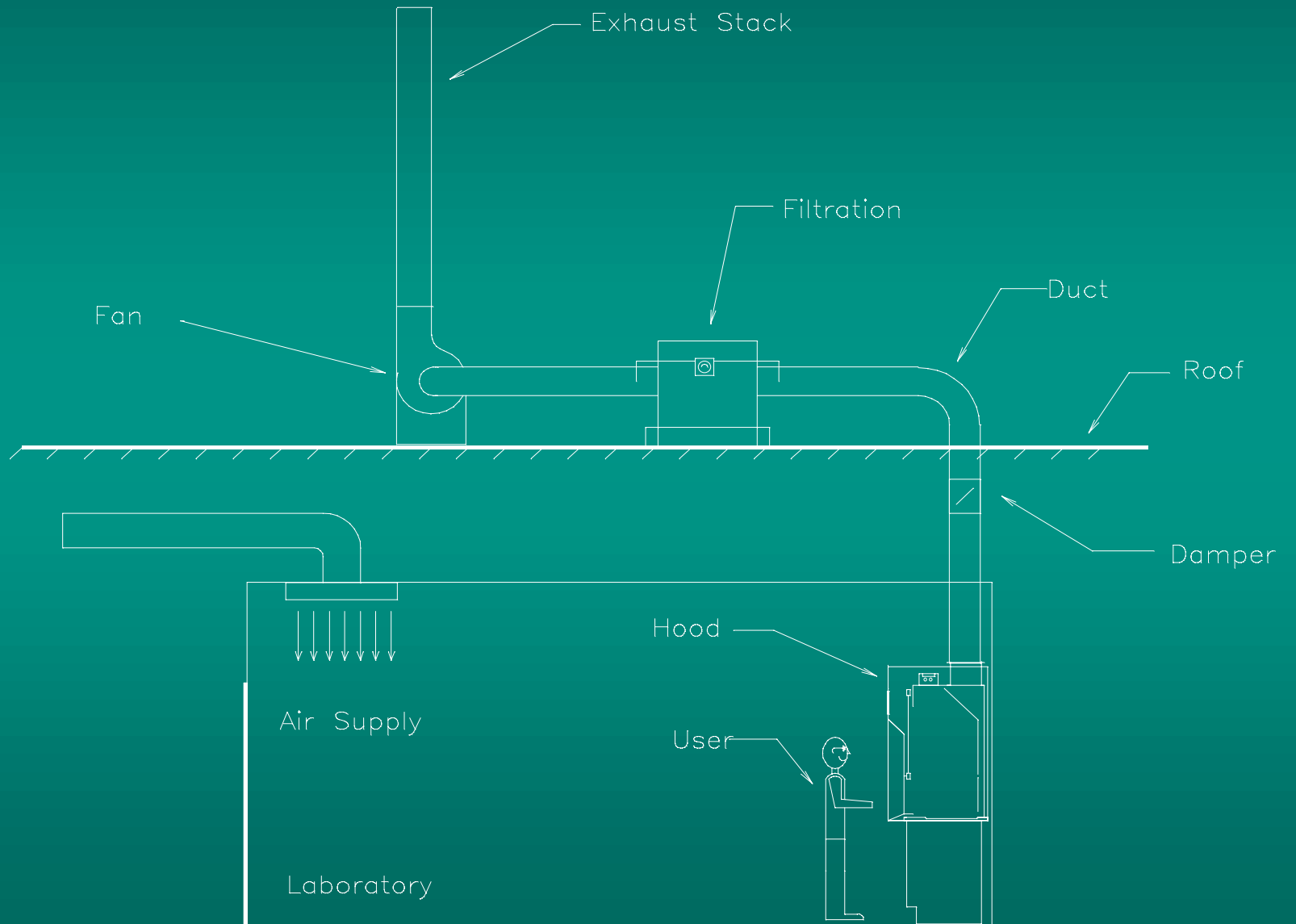
■ Document Proper Hood Performance

■ Collect Baseline Data

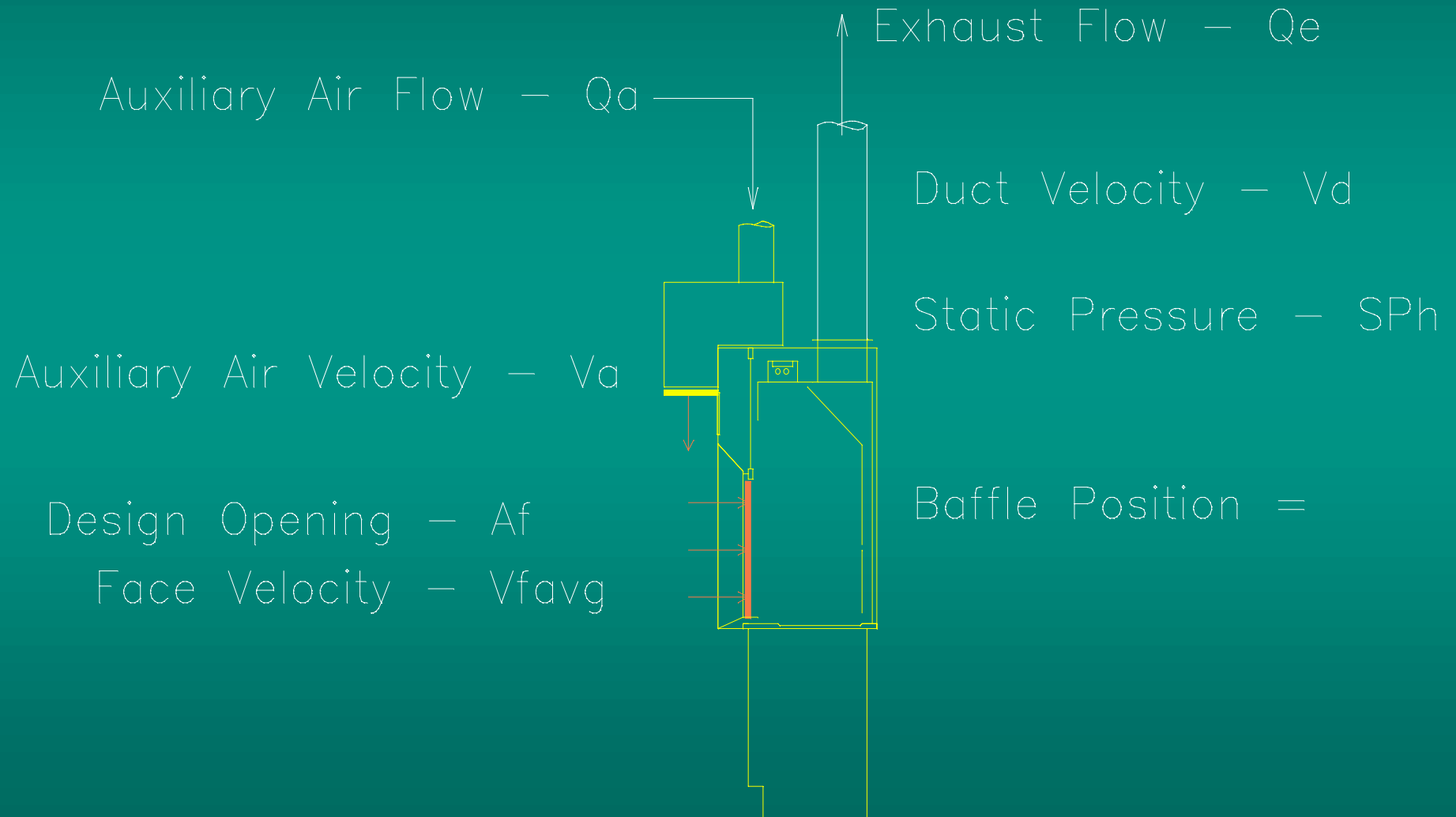
Operating Modes

- **CAV - Single or Manifold Hood Systems**
- **VAV - Sash or Velocity Sensor Controls**
- **Two Position VAV (Night setback)**
- **Modes of Operation**
 - Occupied - In Use
 - Unoccupied - In Use
 - Occupied - Not in Use (Experimental Setup)
 - Unoccupied - Not in Use

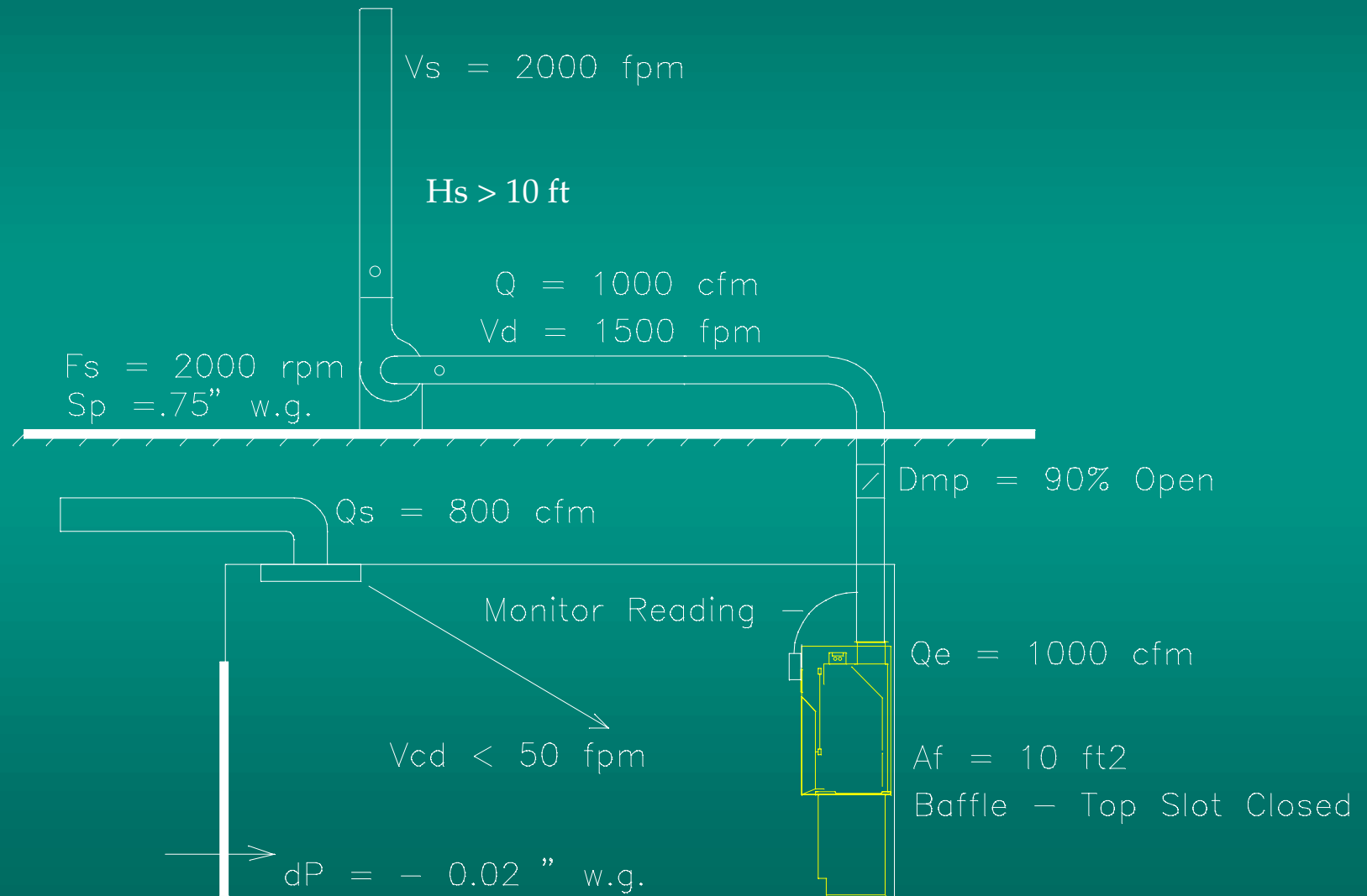
Single Hood - Single Fan CAV System



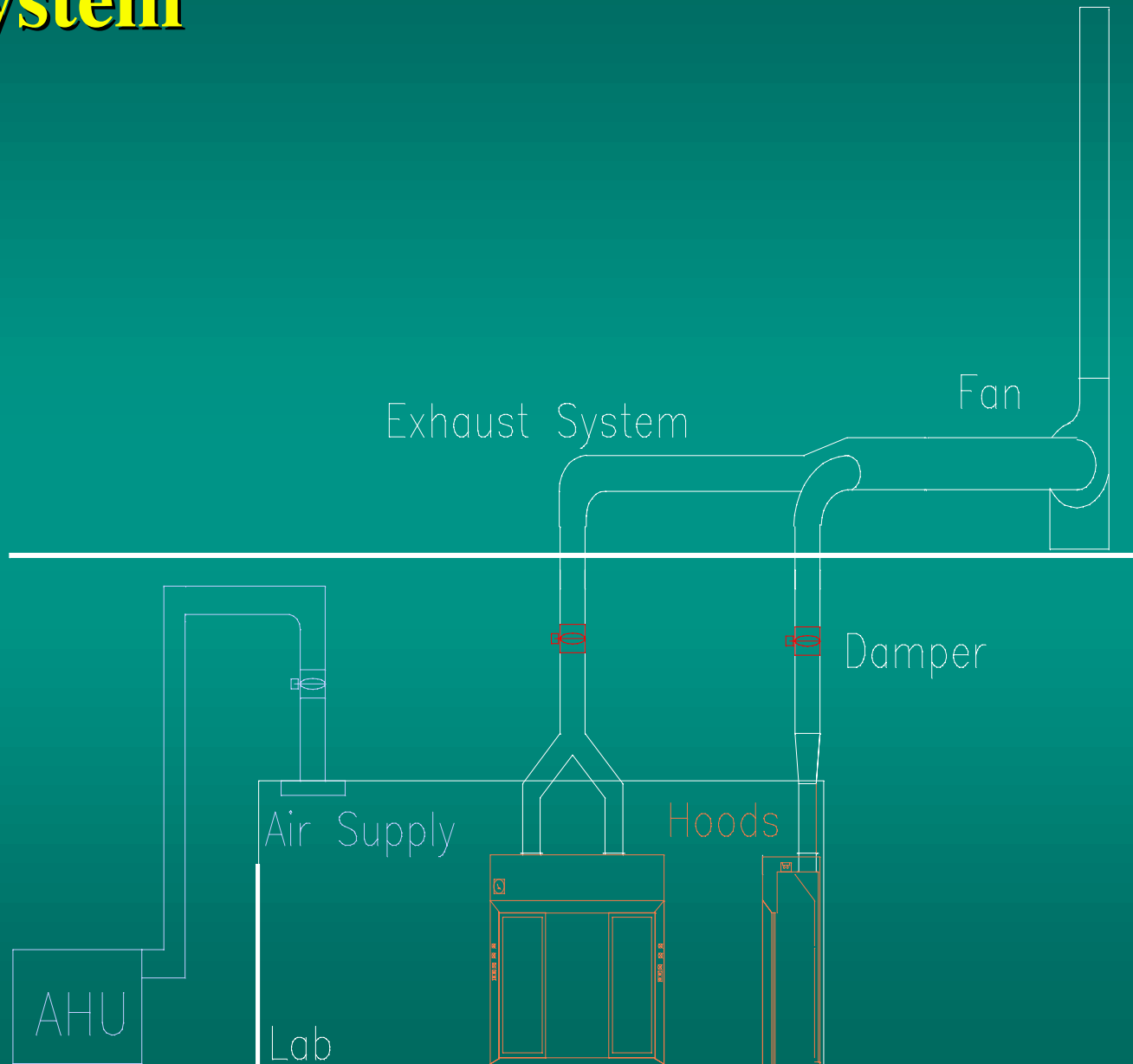
Fume Hood Operating Specifications



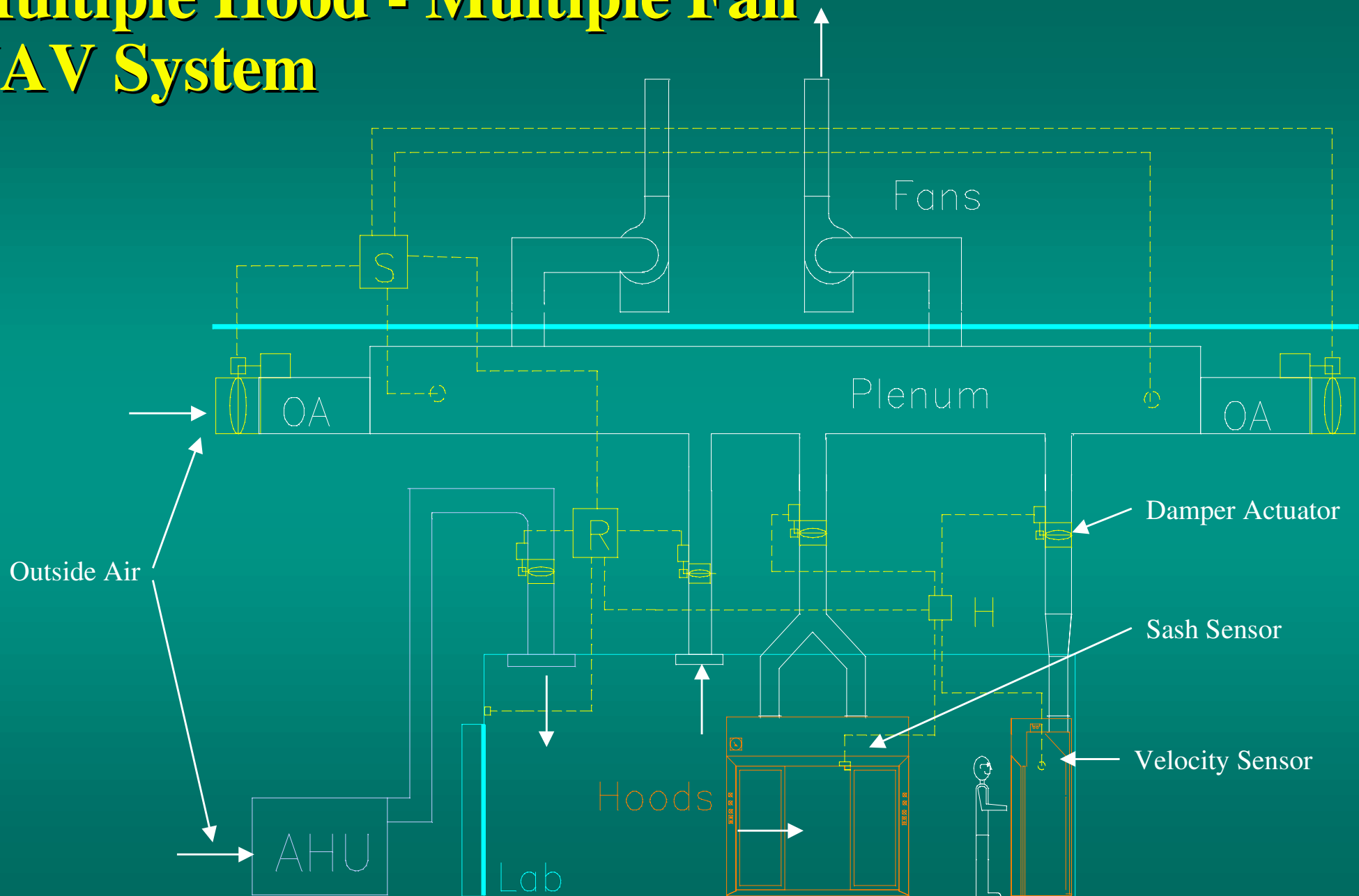
Laboratory Hood System - Operating Specifications



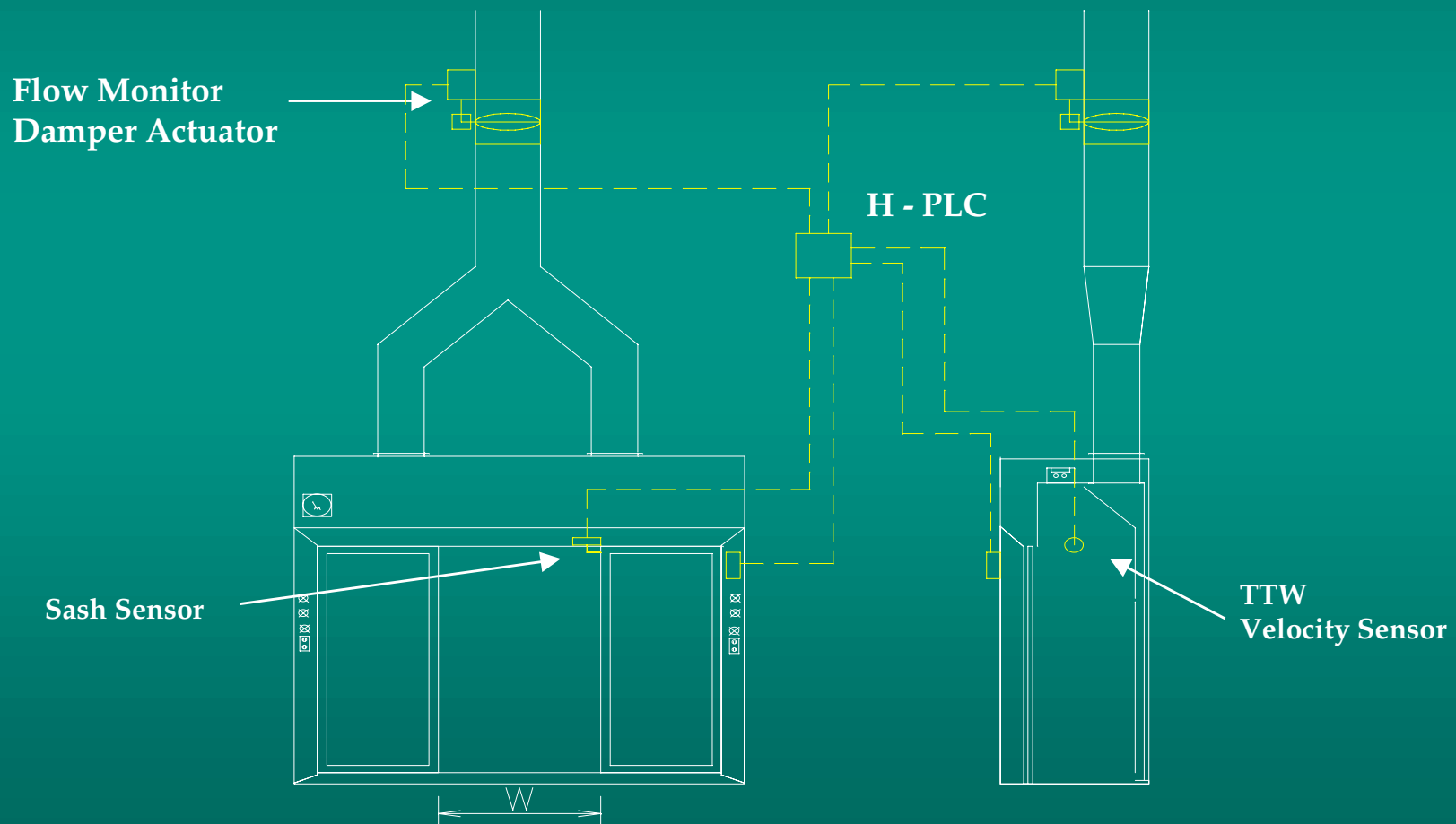
Multiple Hood - Single Fan CAV System



Multiple Hood - Multiple Fan VAV System

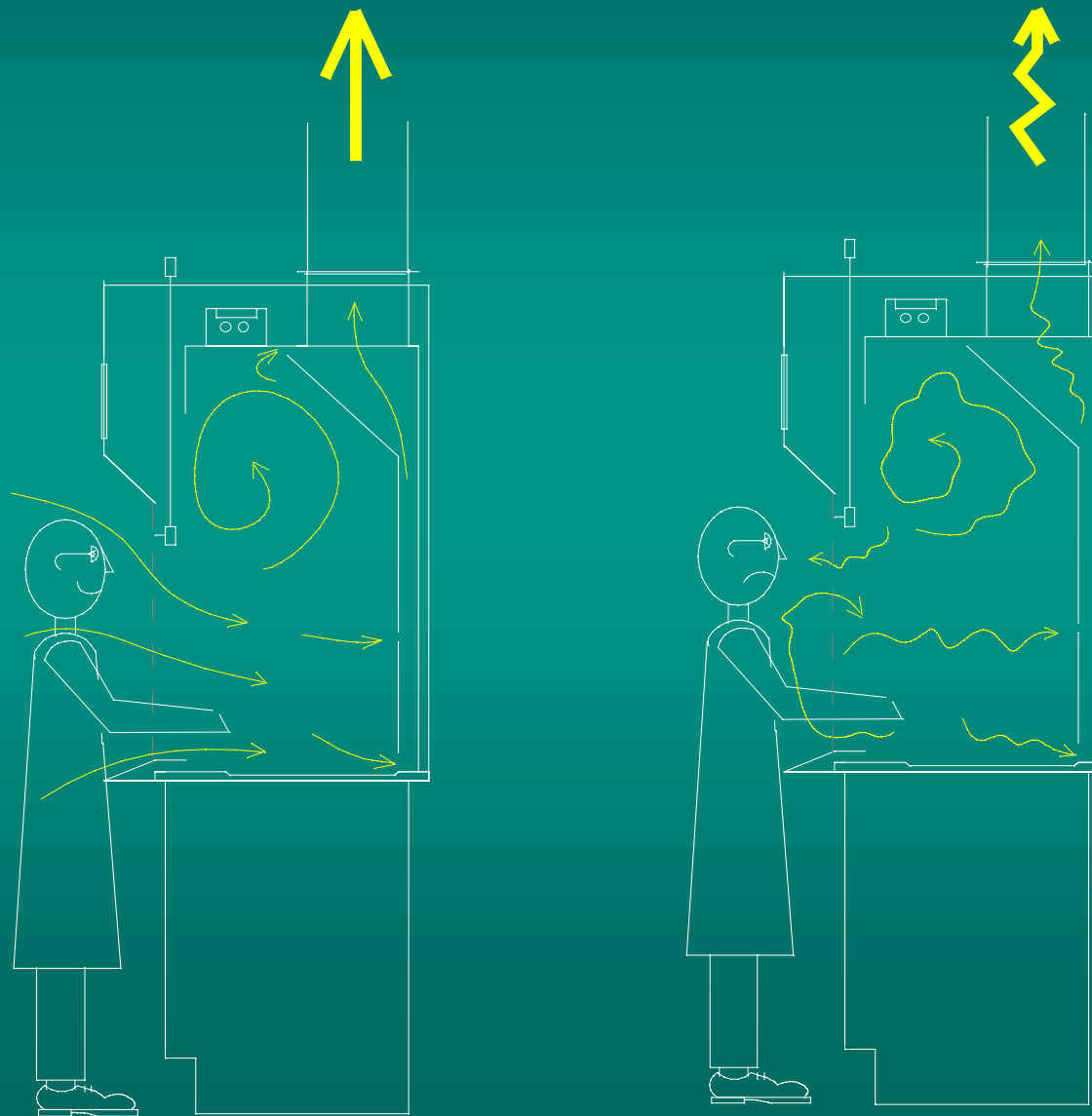


VAV Fume Hood Controls

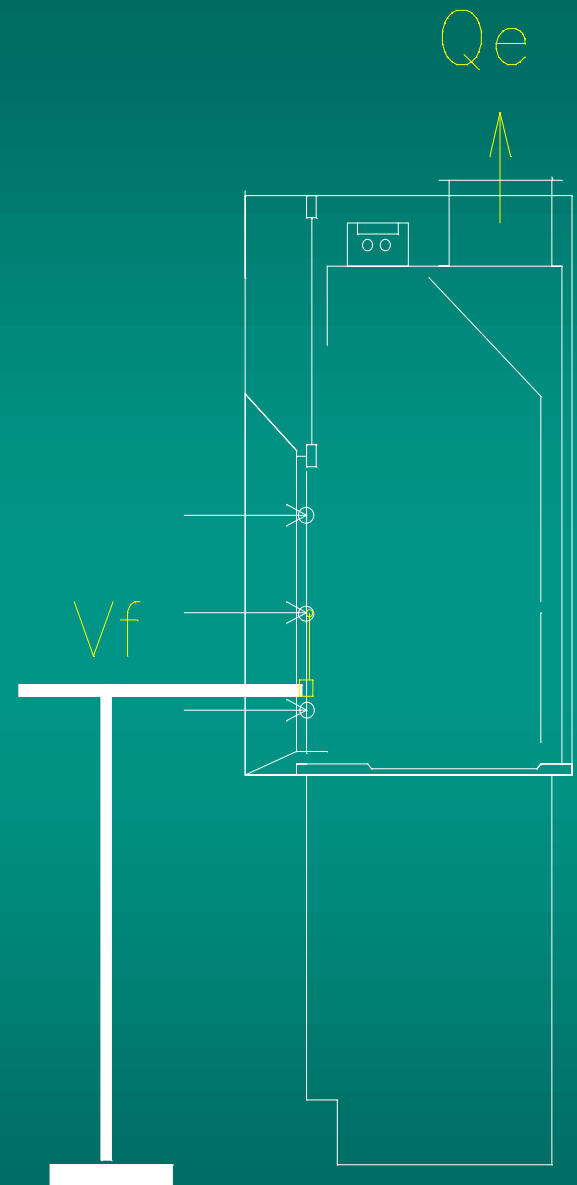
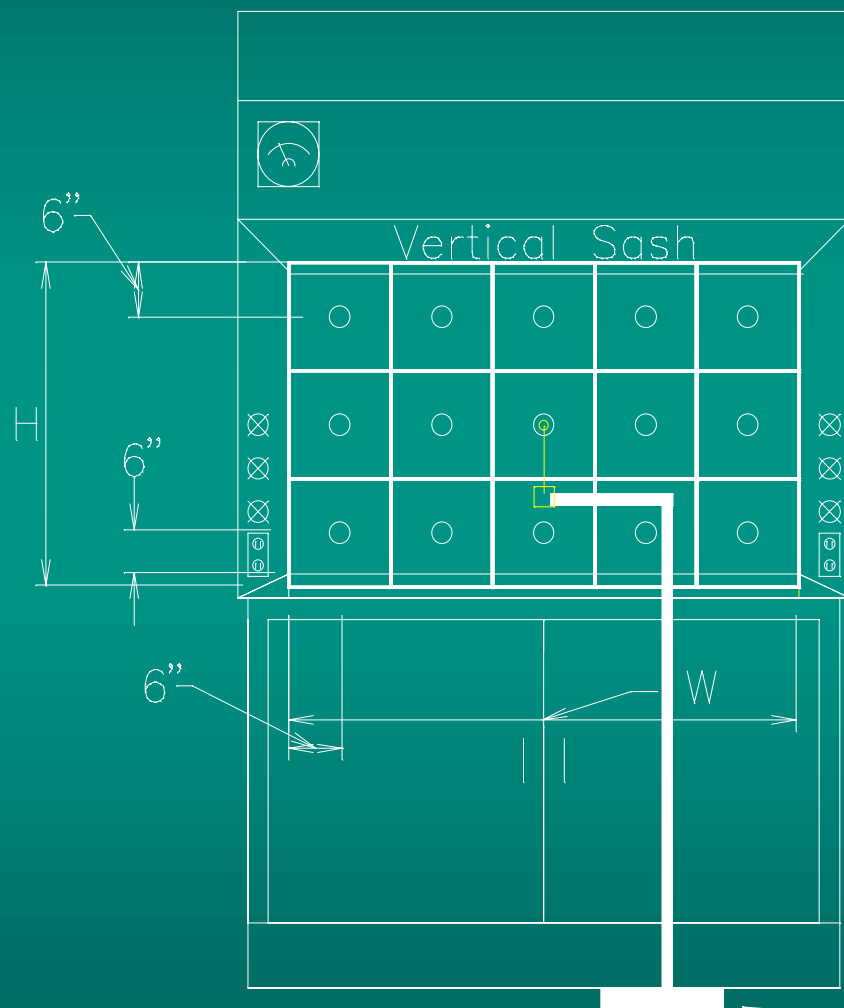




Stable vs. Unstable Exhaust Flow



Face Velocity Traverse



Probe Stand

Face Velocity Traverse Grid

	A	B	C	D	E
1	118	107	81	110	121
2	102	97	54	92	131
3	113	114	75	87	127

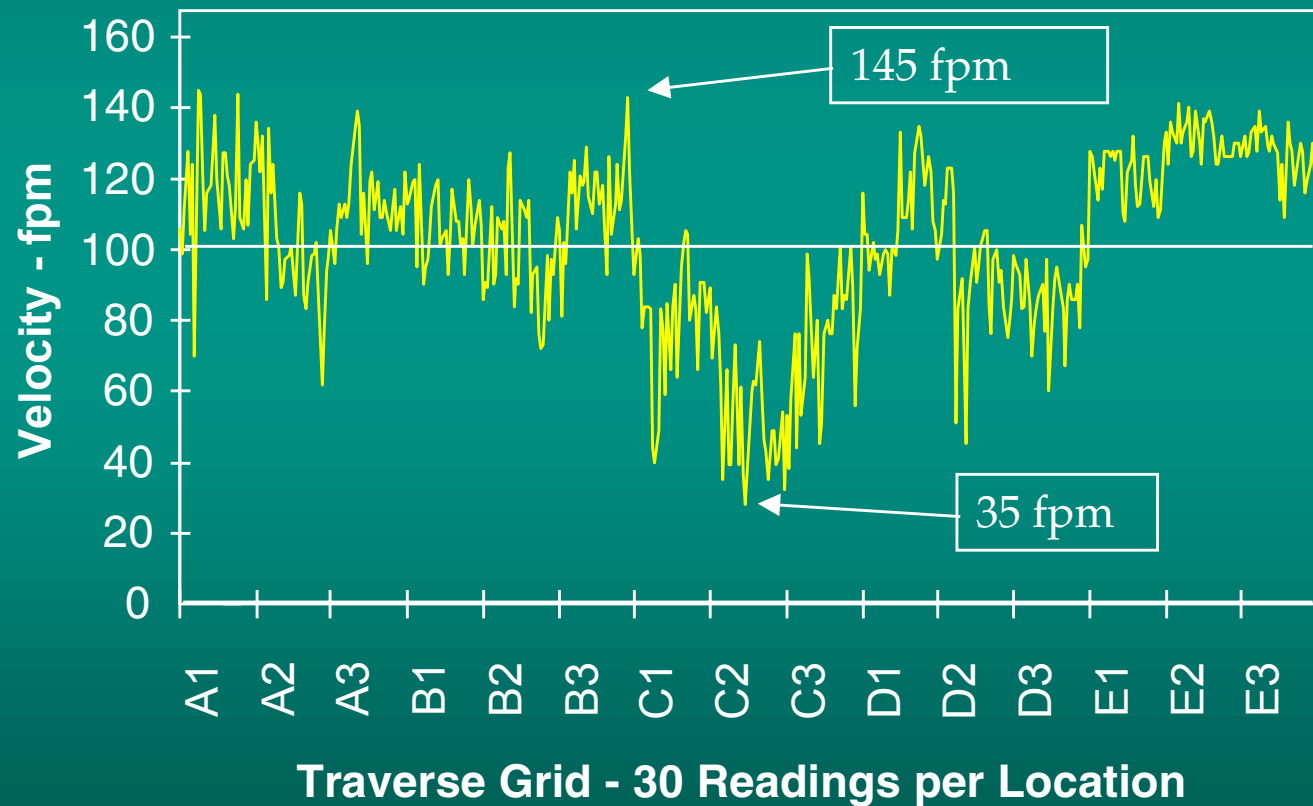
Average = 102 fpm

Max = 131 fpm

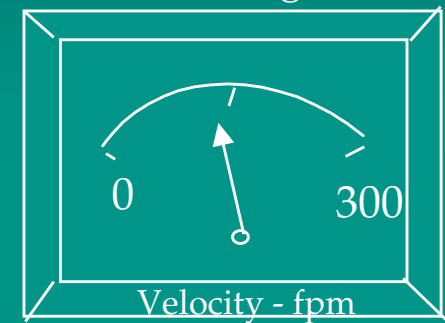
Min = 54 fpm

Face Velocity Traverse

Spacial vs. Temporal Variation



Analog



Digital

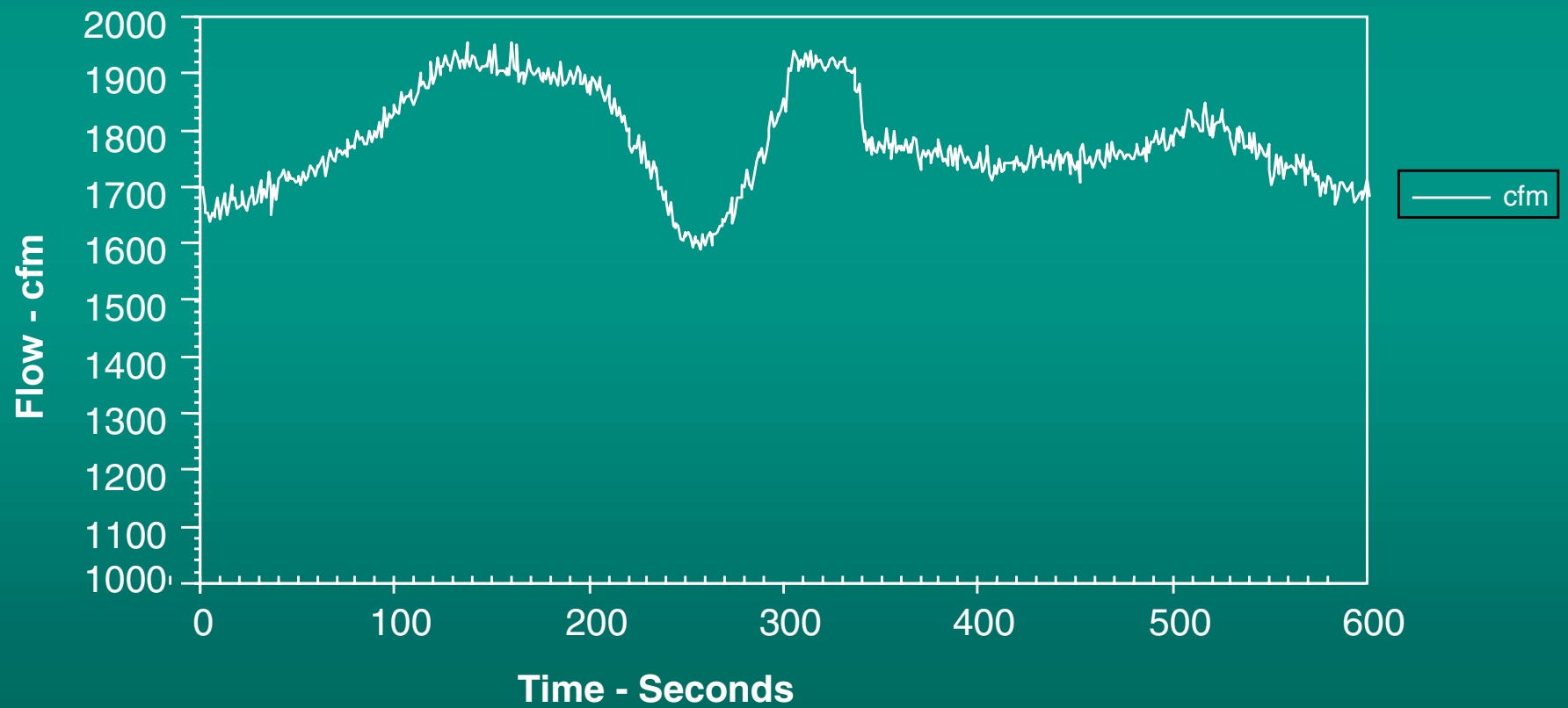


Average = 102 fpm

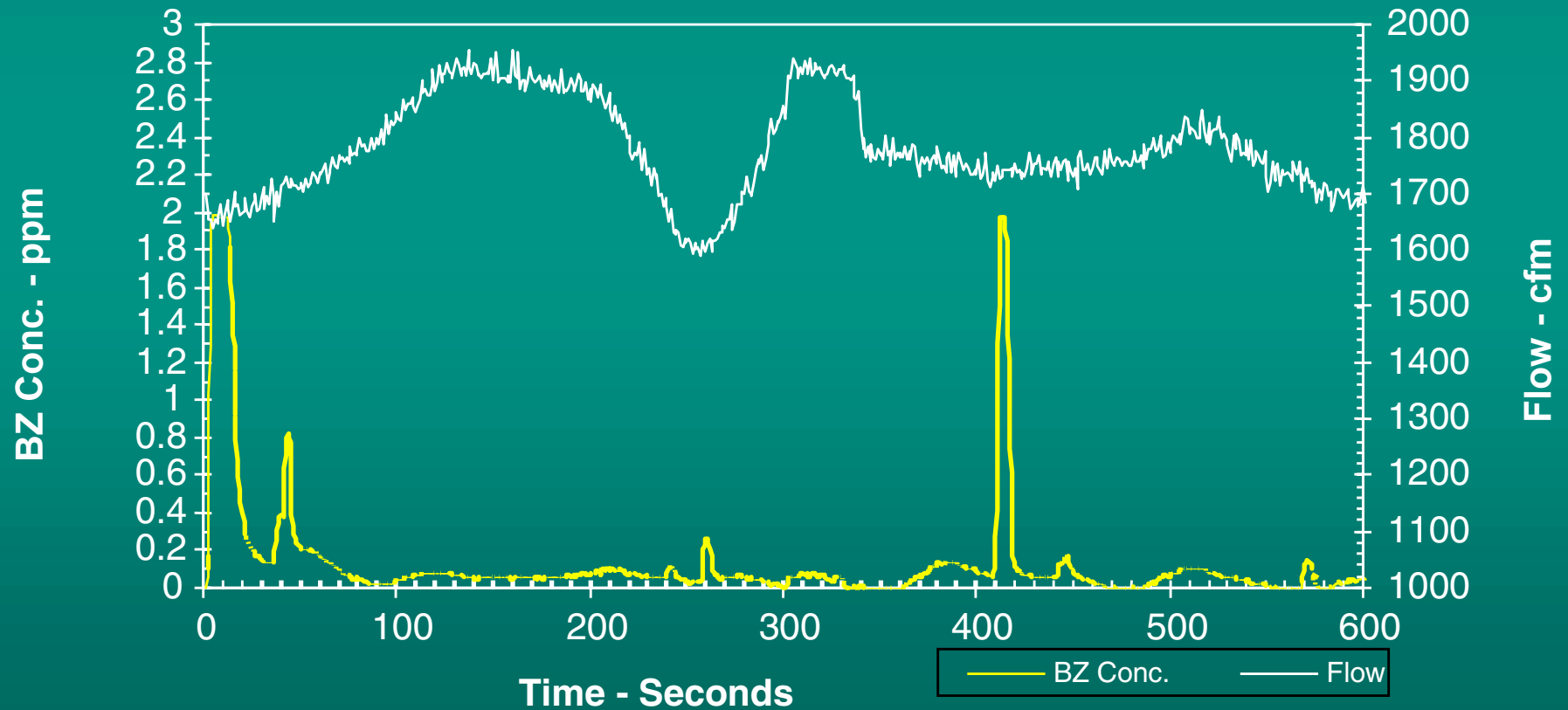
Max = 145 fpm

Min = 35 fpm

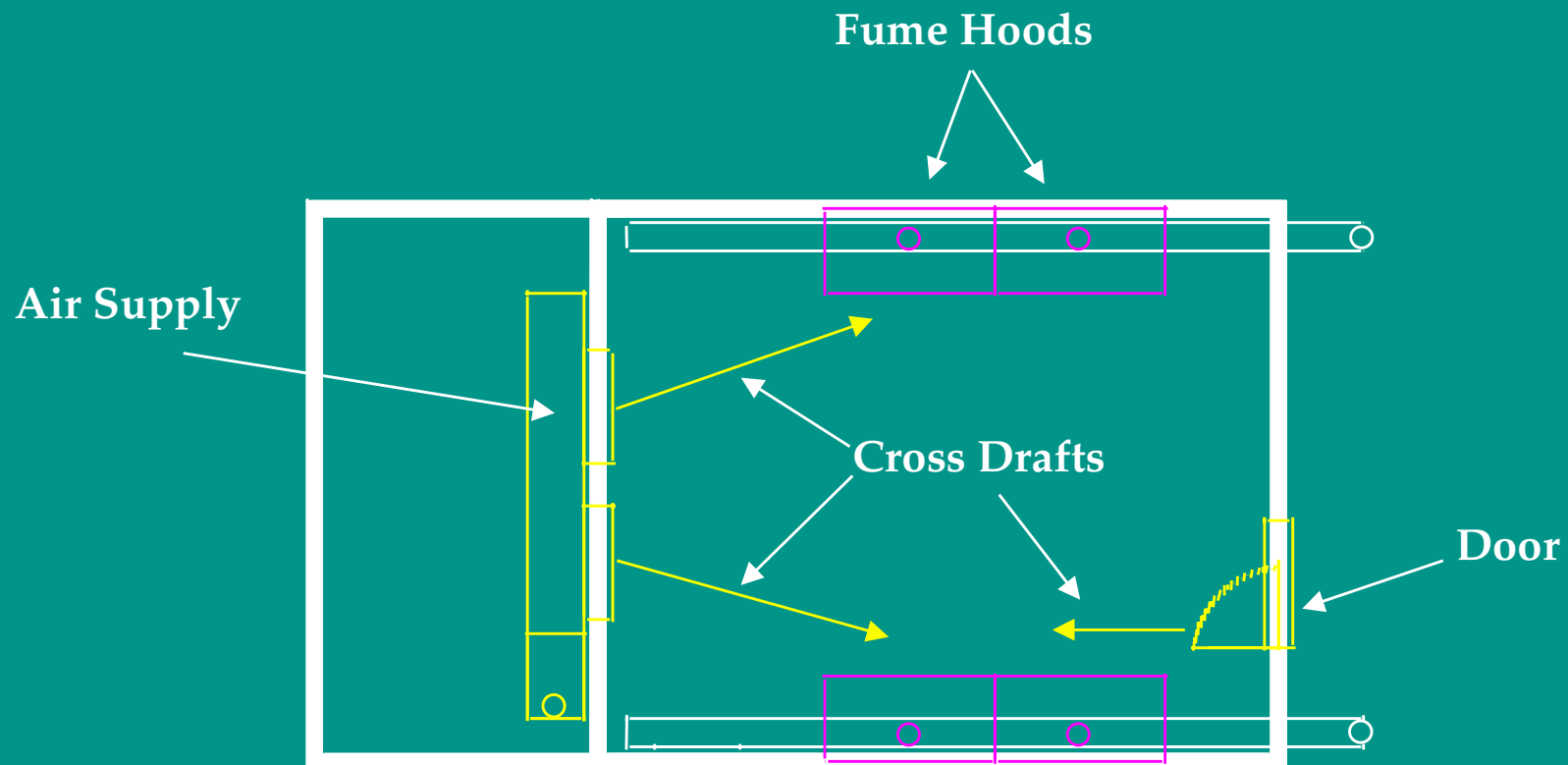
Trend Plot - Exhaust Flow



Trend Plot - Tracer Gas and Exhaust Flow



Typical Laboratory Design

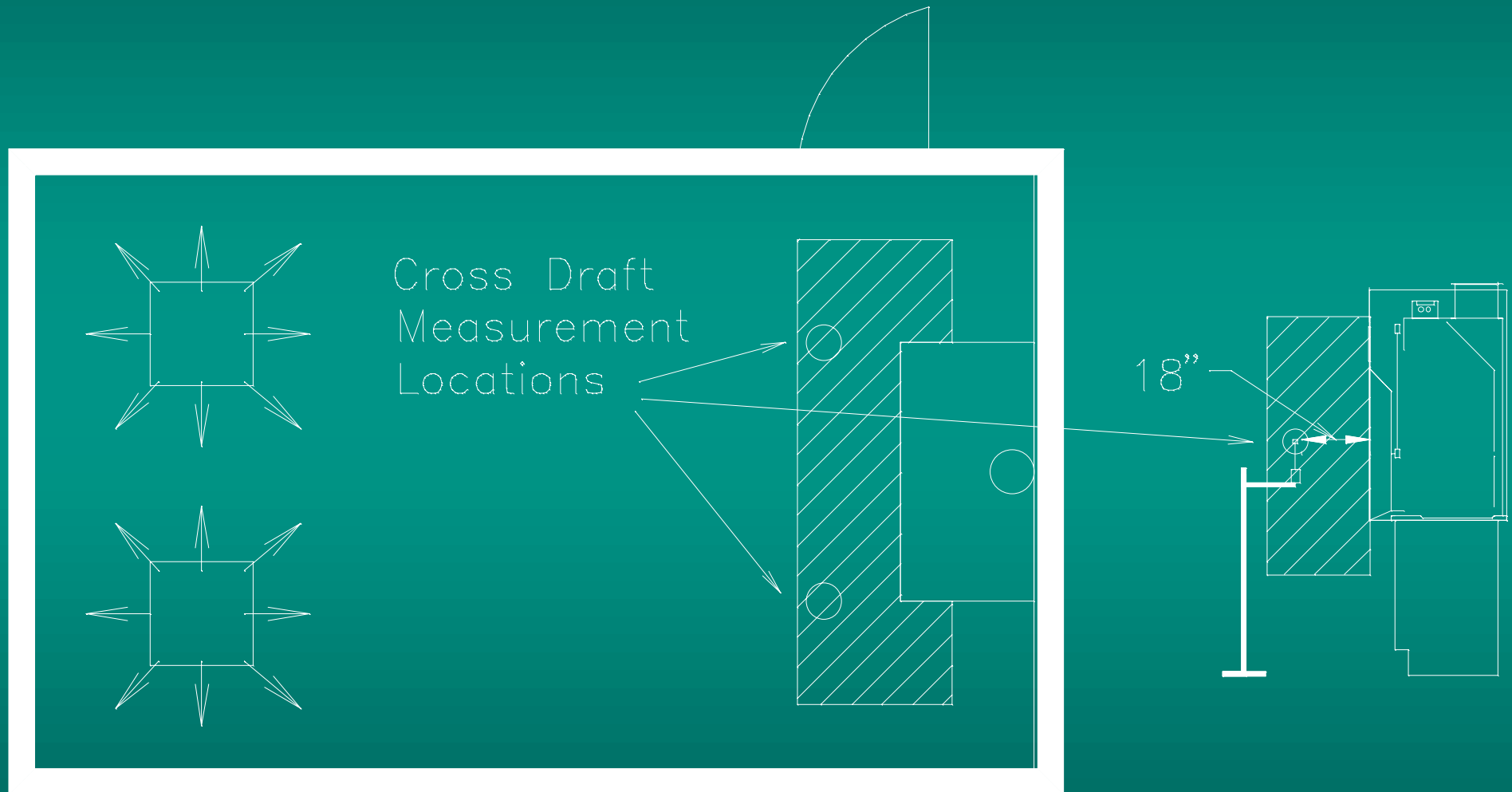


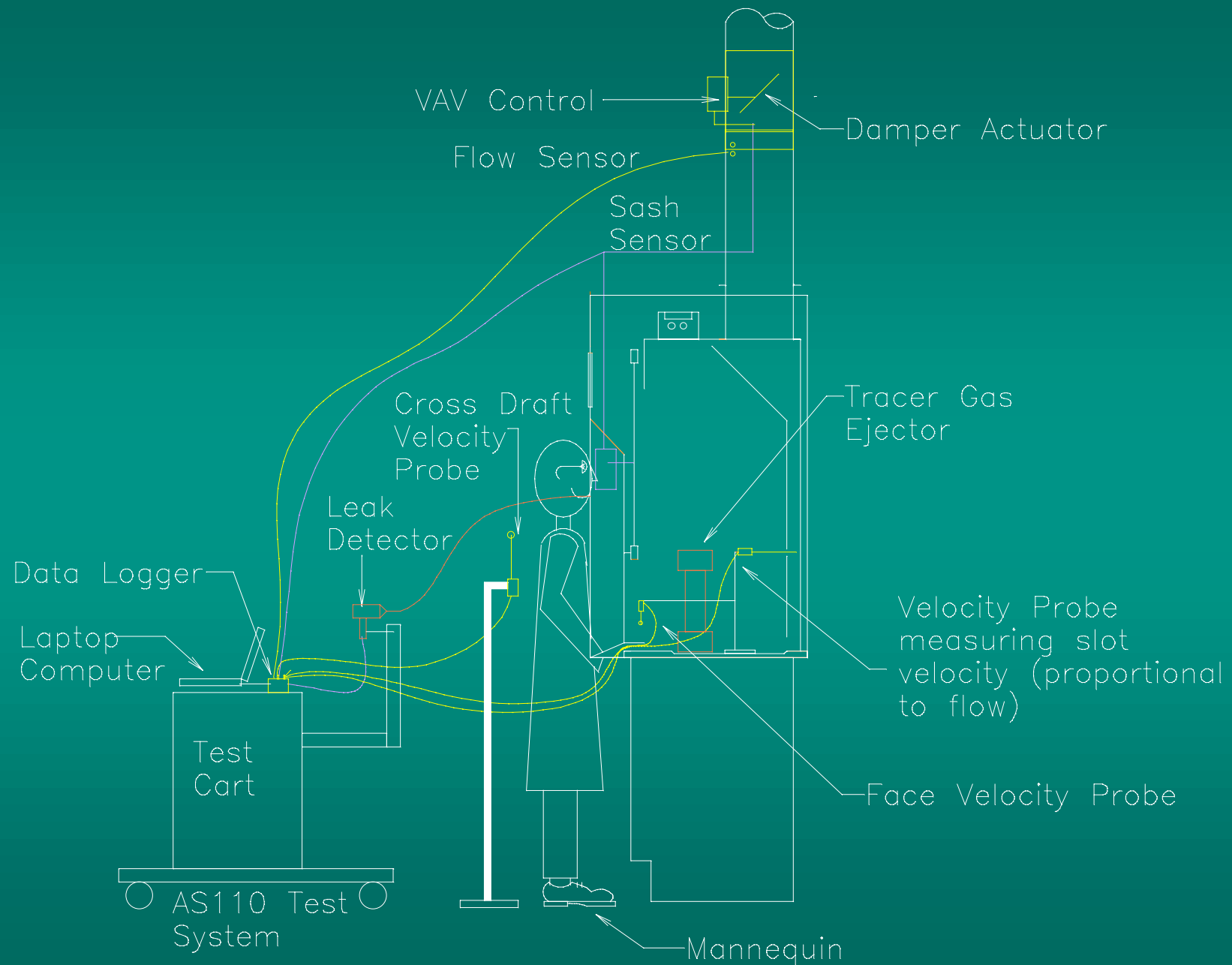
- Diffuser Selection
- Diffuser Location
- Avoid High Velocity Discharge Diffusers
- Avoid Directing Discharge Towards Hood Opening
- Keep Terminal Velocities < 30 fpm.



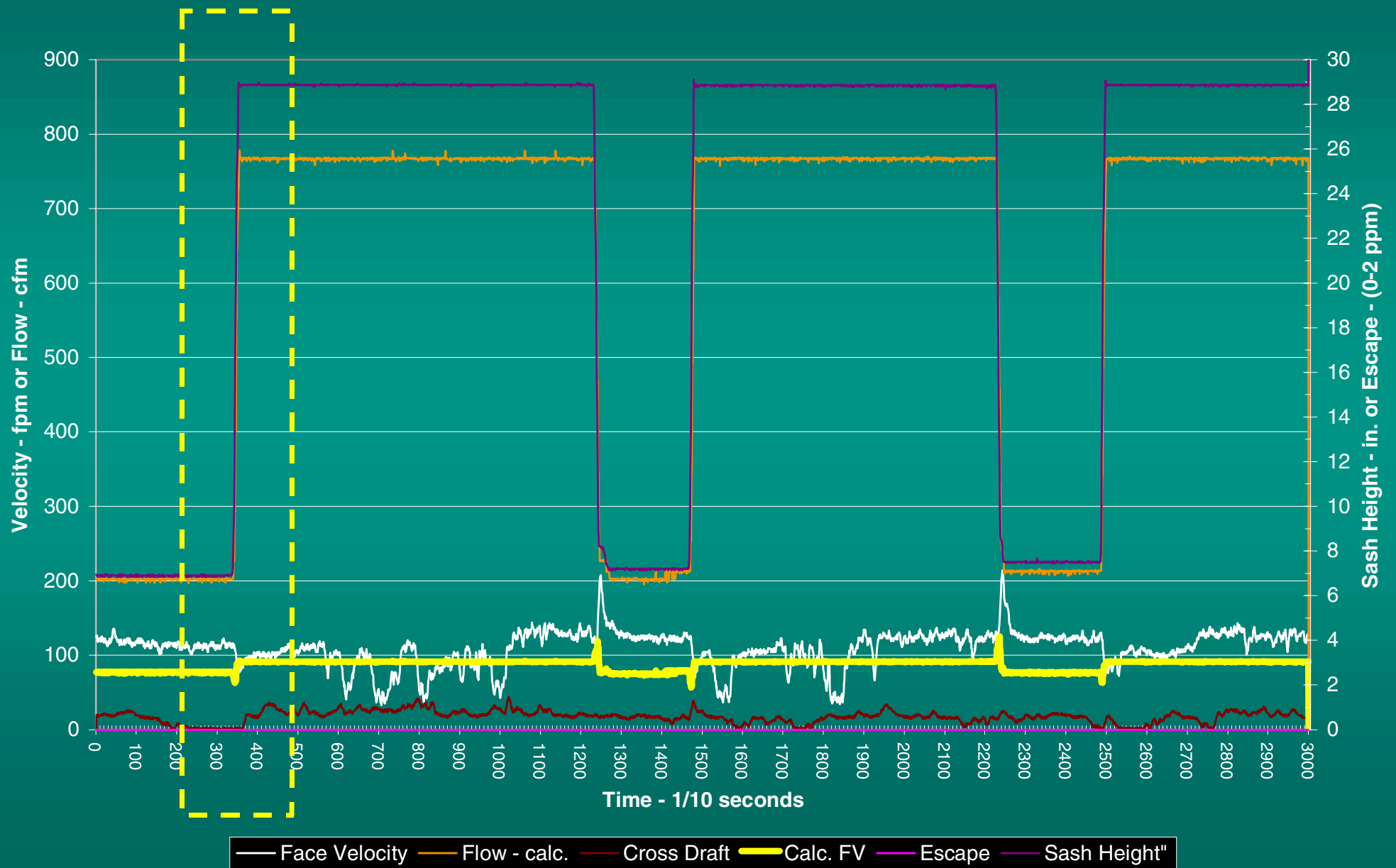


ECT Cross Draft Measurements





VAV Response to Sash Movement from 25% open to 100% open without mannequin For Hood 2604

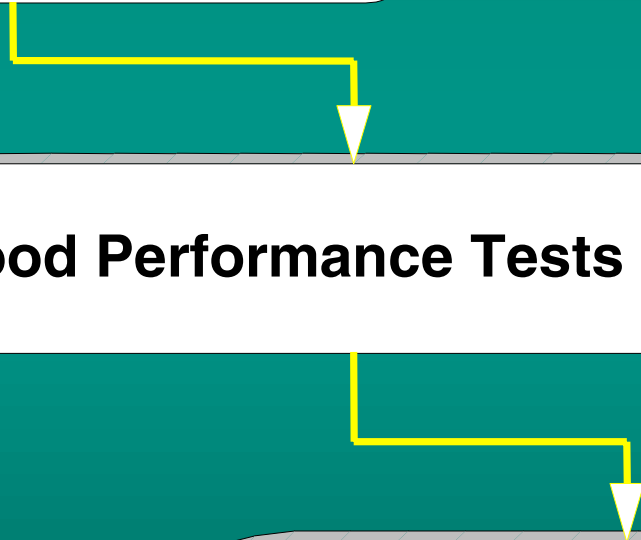


Commissioning of Laboratory Hood Systems

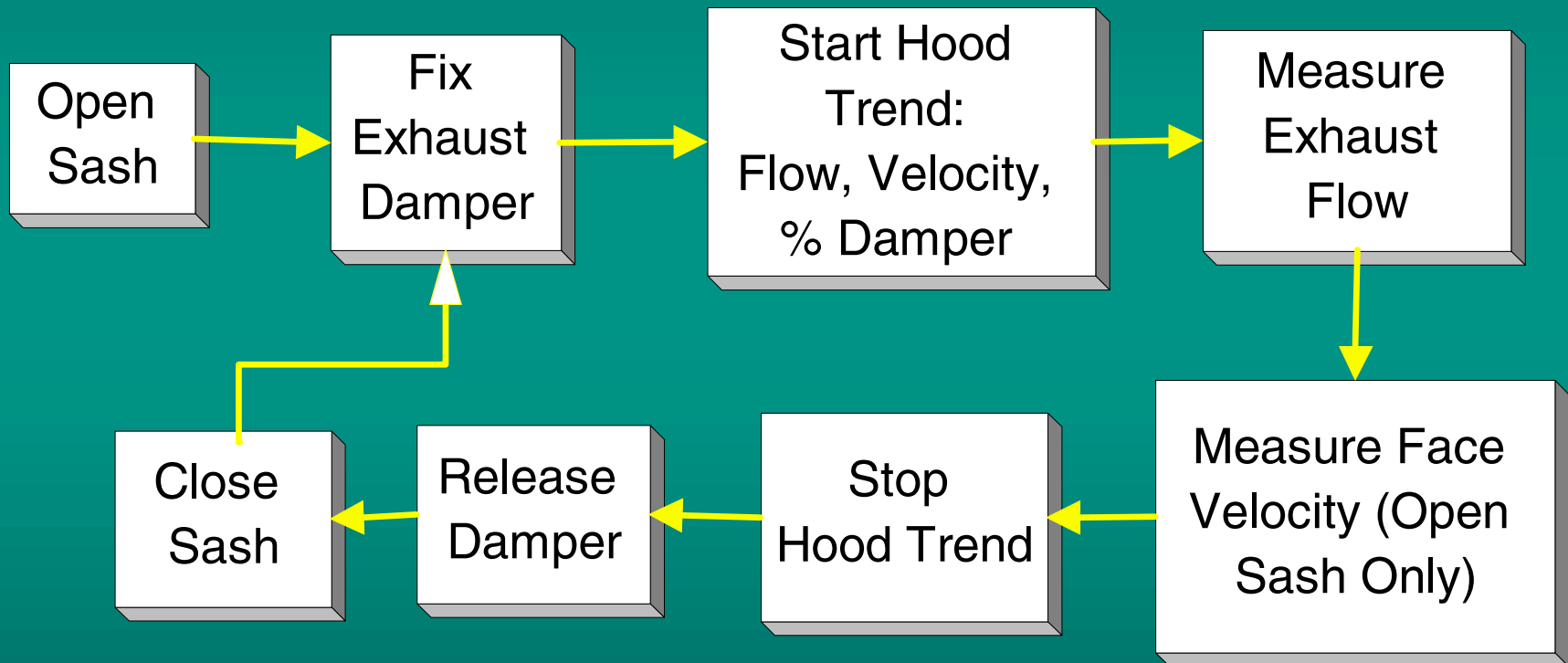
**Sensor
Calibration Test**

Hood Performance Tests

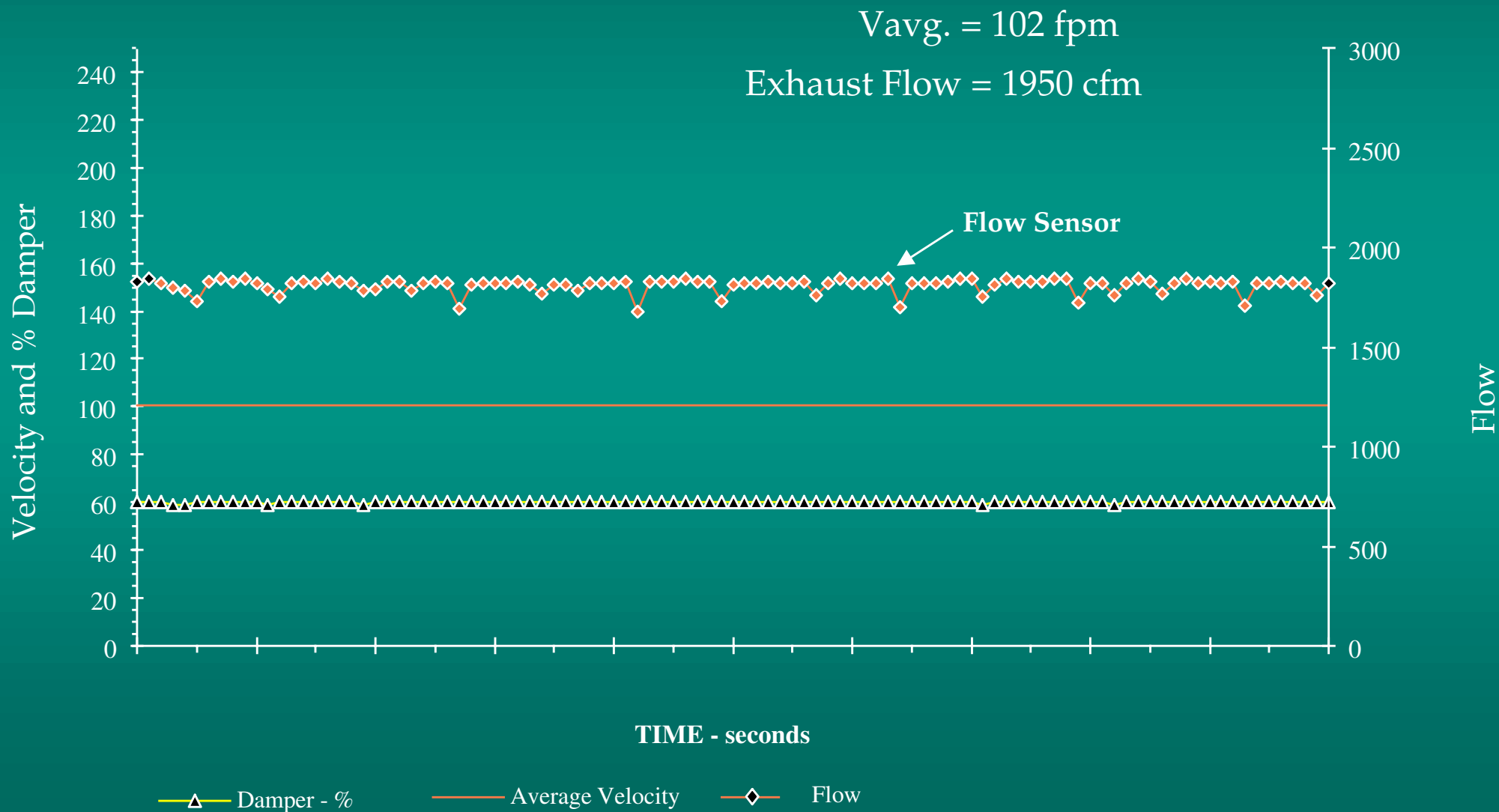
**VAV Laboratory / System
Response Test**



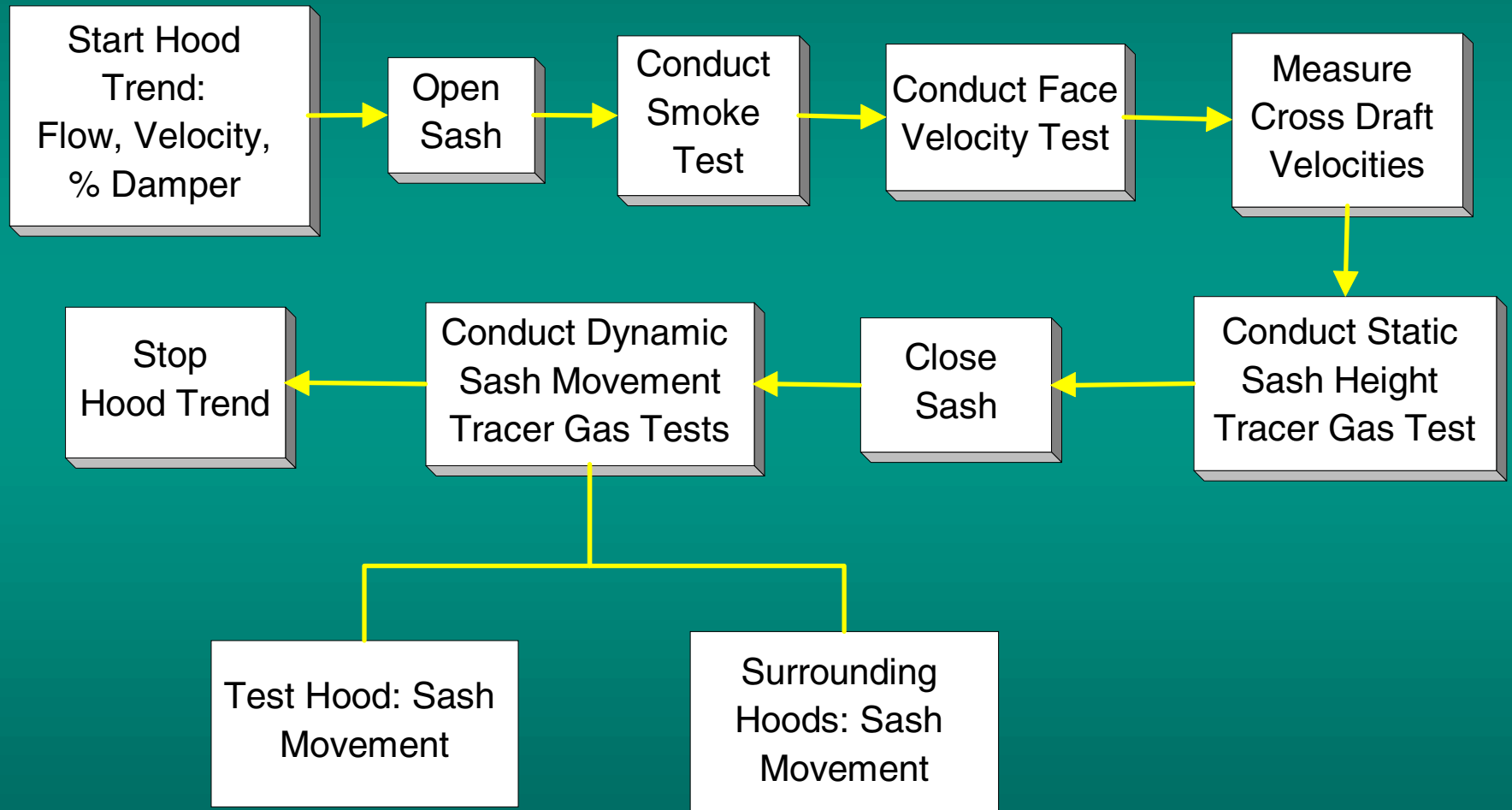
Two Point VAV Sensor Calibration Test



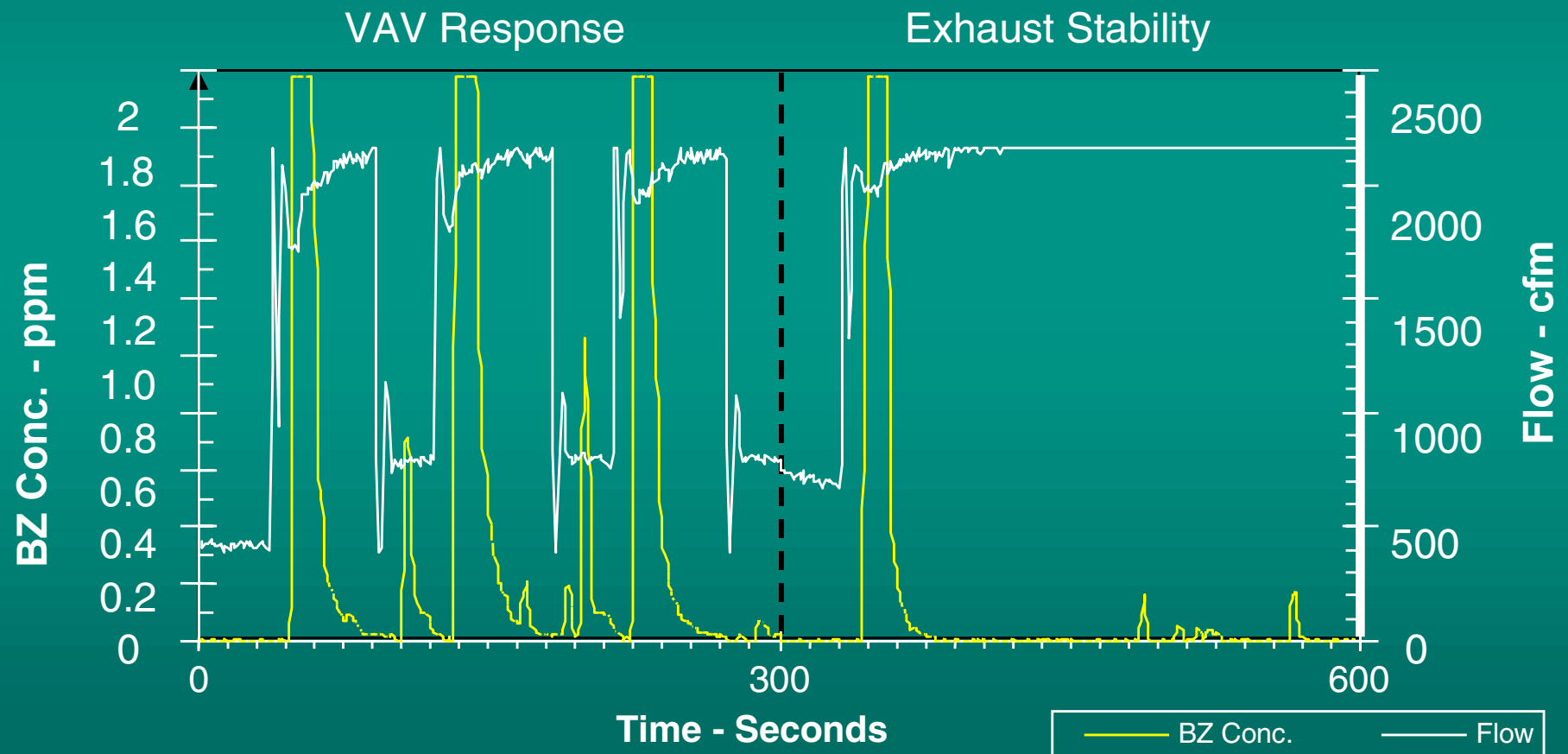
Calibration Trend - Hood Exhaust Flow



VAV Hood Performance Test

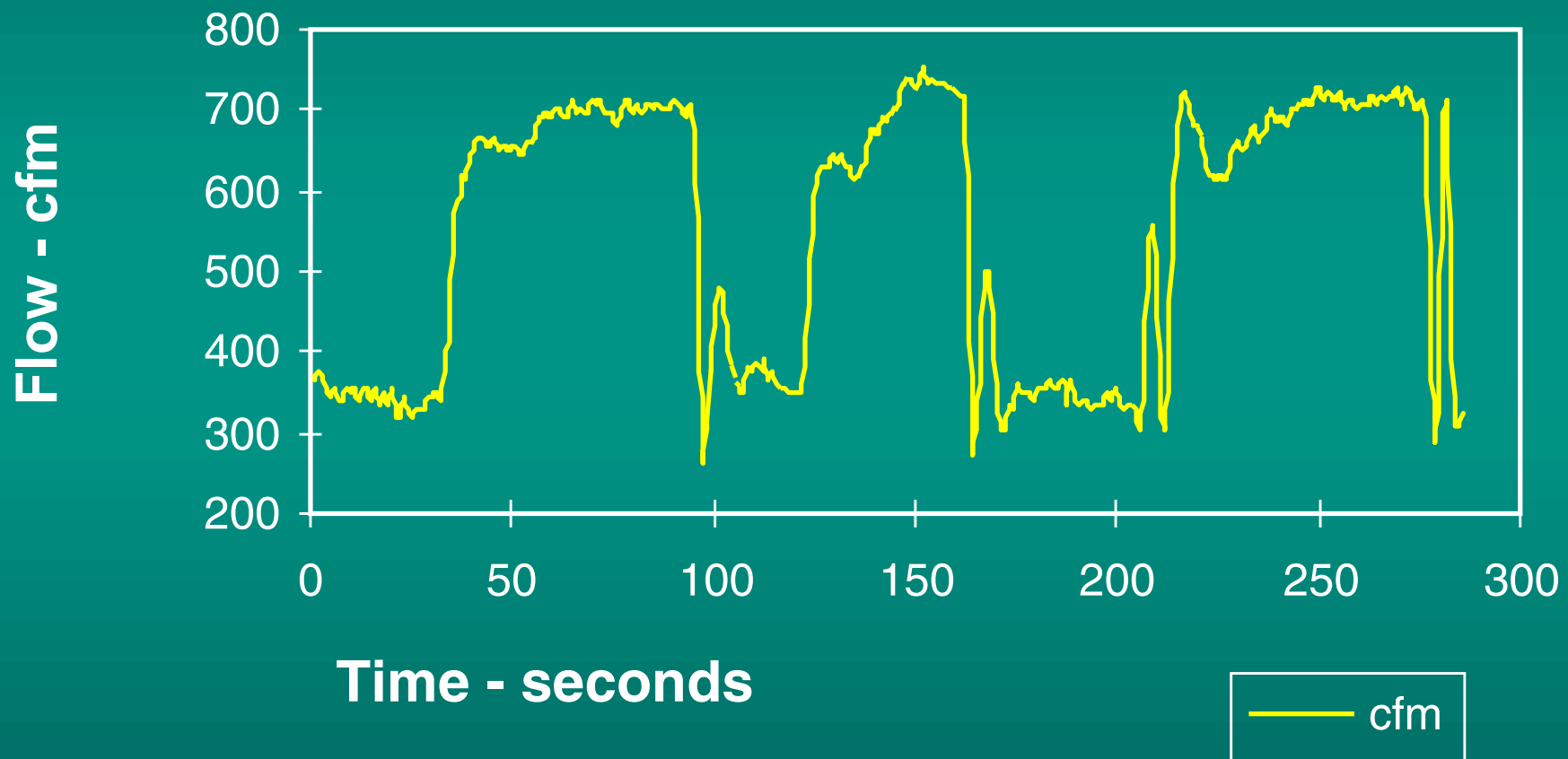


Evaluating VAV Response and Stability

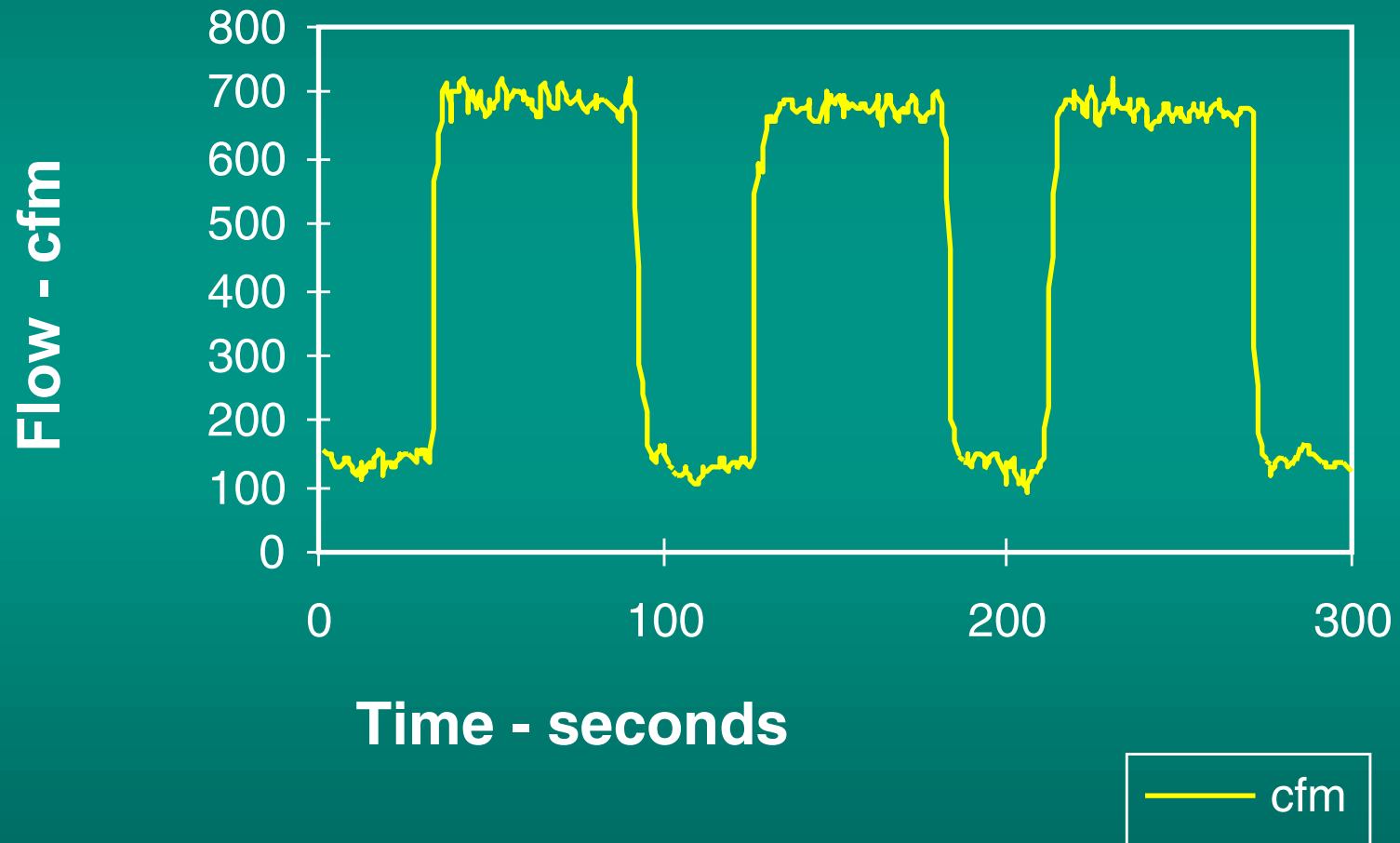


VAV Flow Response - Sash Movement

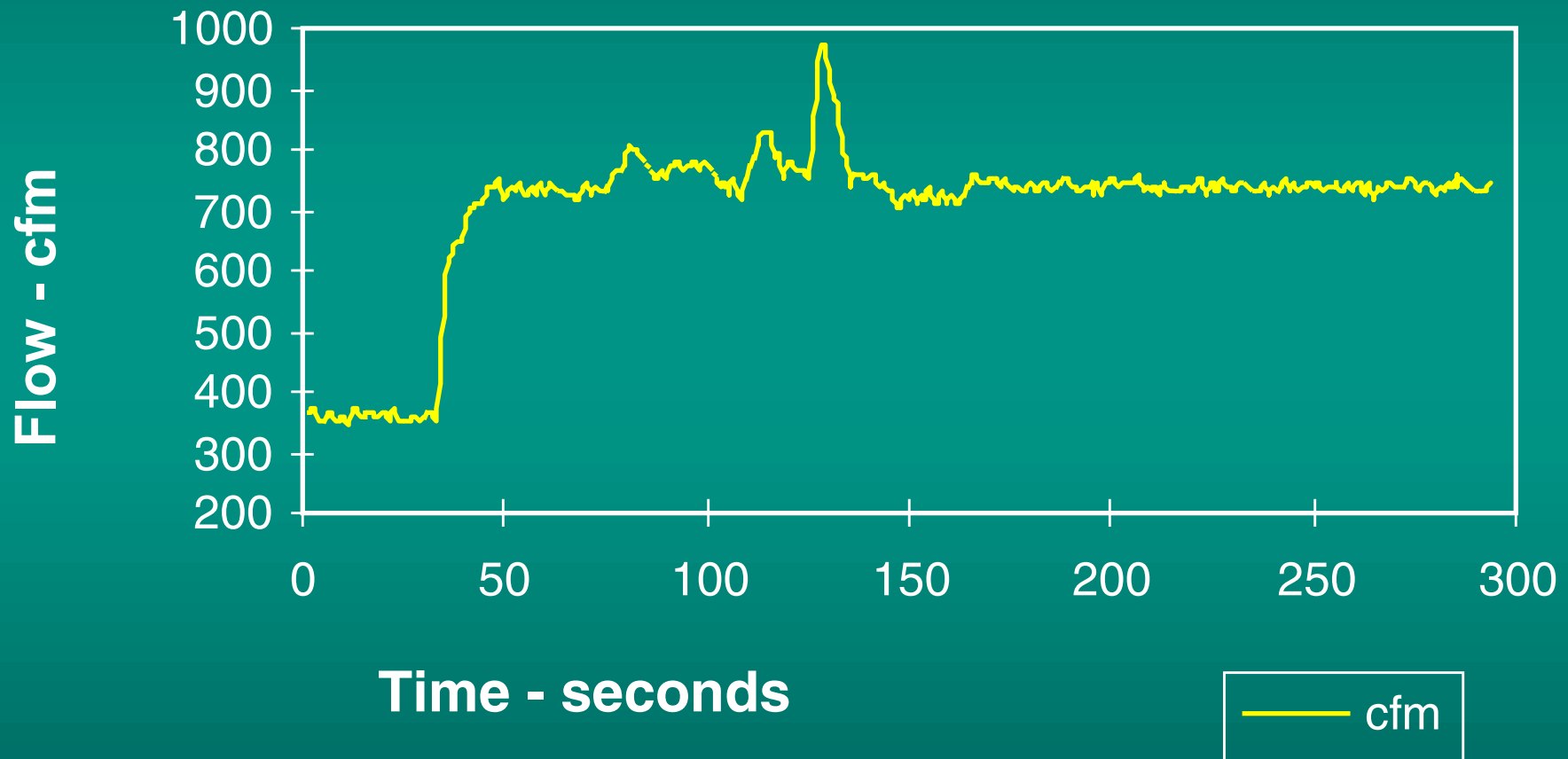
Diagnose Tuning



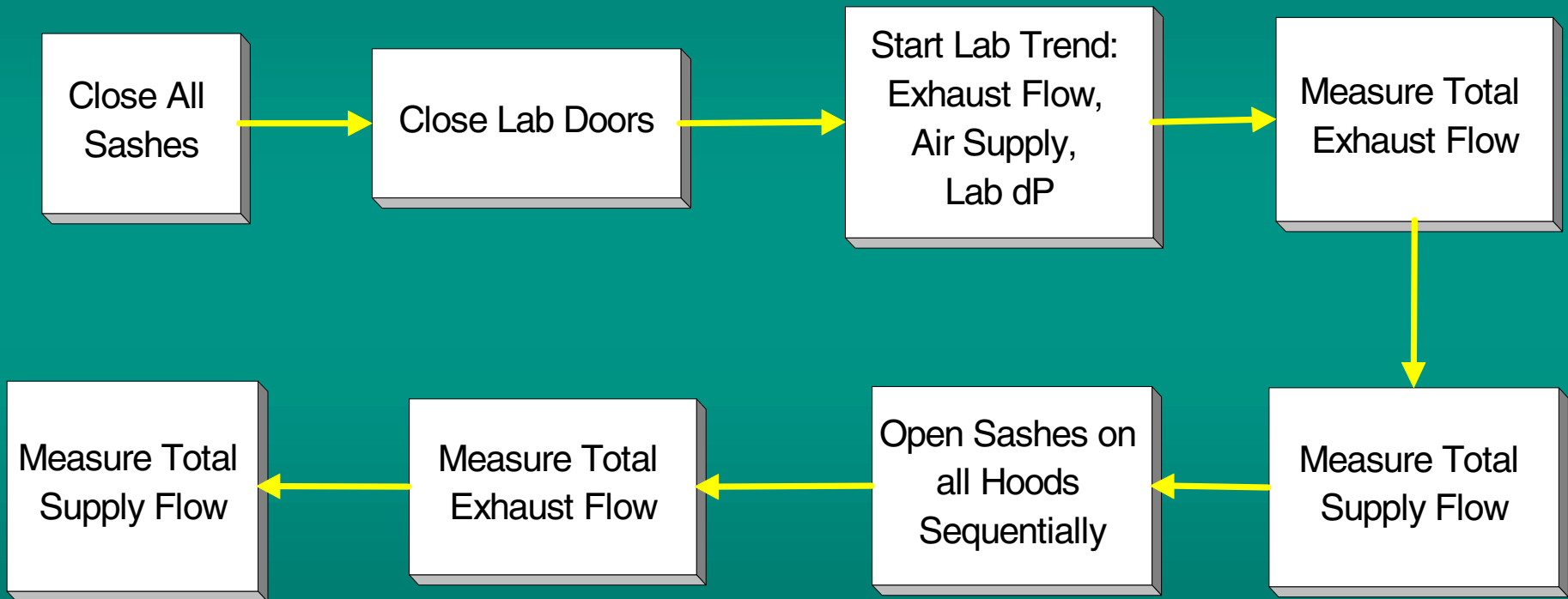
VAV Flow Response - Sash Movement



VAV System Stability Test

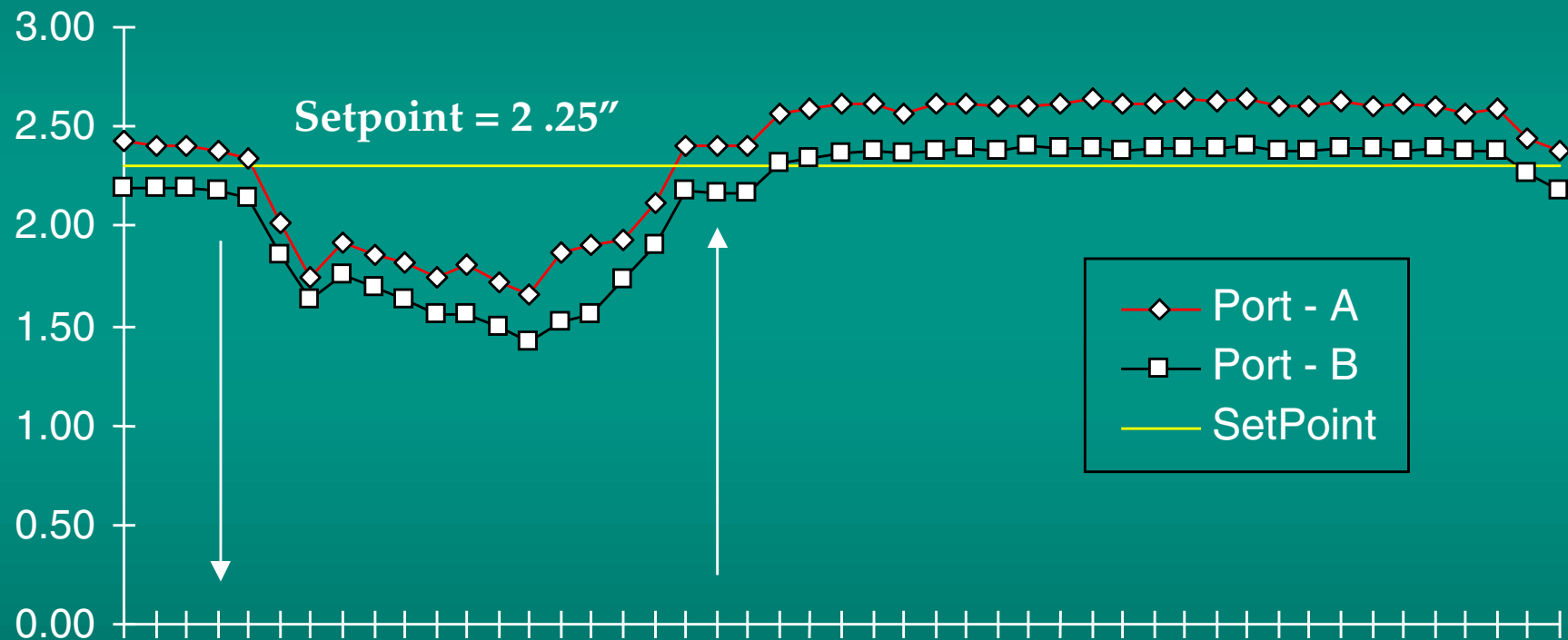


VAV Laboratory / System Response Test



Constant Static Pressure Plenum

Trend Plot - Static Pressure vs Time of Day



Time of day - August 12-13, 1993

**Outside Air
Bypass Damper**



Commissioning Documentation

- **Final As Built Drawings**
- **Final Test and Balance Report**
- **Results of Commissioning Tests**
- **Summary of Baseline Data**
- **Summary of Operating Constraints**

Evaluating Ventilation System Performance

Few things will confound a study more than treating a variable as a constant.

For every complex problem there is a simple, easy to understand solution and it is wrong.